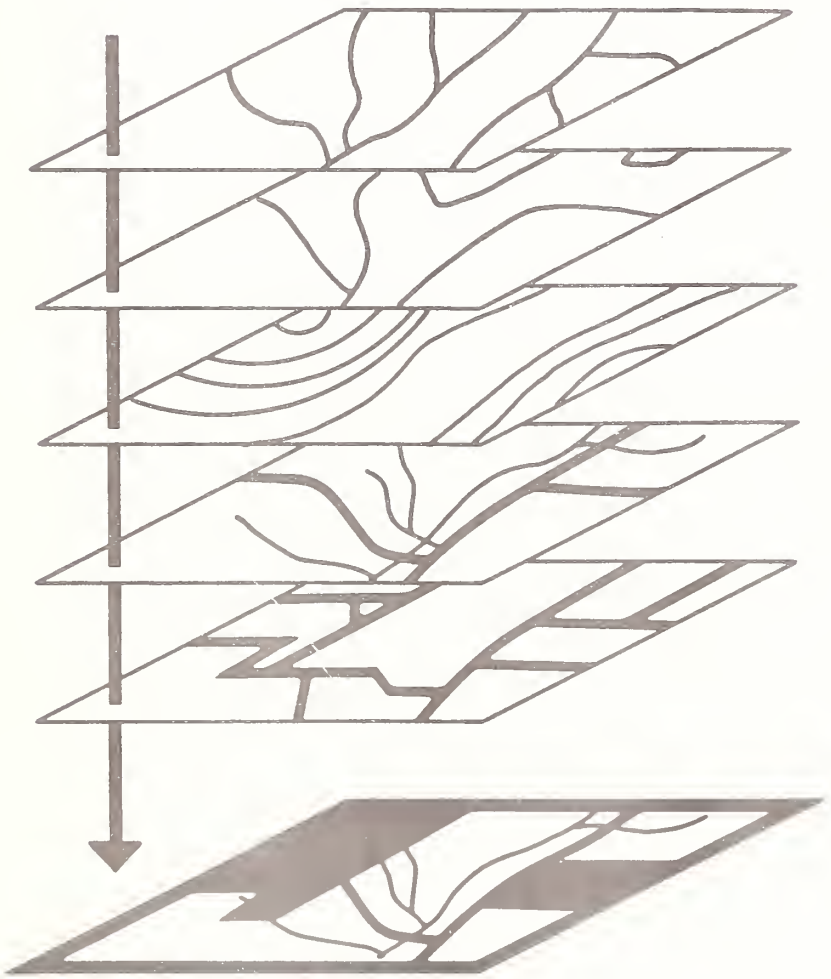
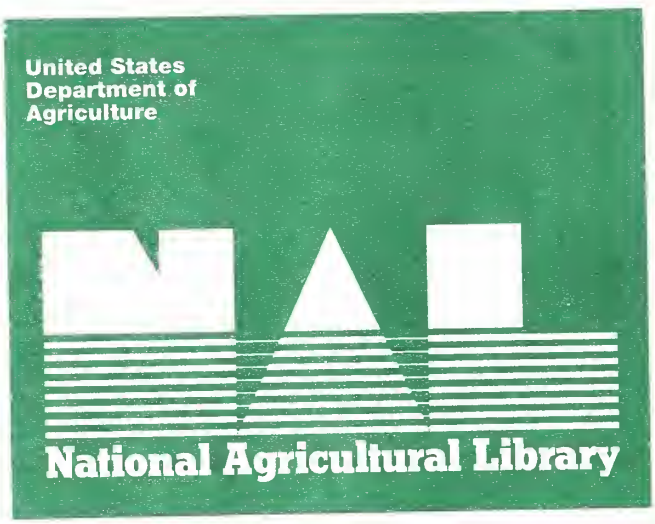
U.S. DEPARTMENT OF AGRICULTURE
GEOGRAPHIC INFORMATION SYSTEMS
WORK GROUP

REPORT TO THE SECRETARY
FEBRUARY 1991




United States
Department of
Agriculture
National Agricultural Library

DEPARTMENT OF AGRICULTURE

SUBJECT: USDA Geographic Information System Work Group

TO: James R. Moseley, Assistant Secretary, NRE

Enclosed is a report regarding accomplishments and planned activities of the USDA Geographic Information System (GIS) Work Group. Since the Work Group was established in April 1989, the awareness of GIS among USDA agencies has greatly increased. Our monthly meetings have progressed from providing general awareness of GIS to identifying and resolving cross-cutting issues facing the Department of Agriculture.

The Work Group will continue ensuring coordination of GIS activities within USDA and with other departments and independent agencies. Activities that support the development of necessary digital data base standards and promote cooperation and data sharing with all of our cooperators will also be pursued.

Charles R Hartgraves

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I. BACKGROUND

Introduction

The use of a Geographic Information System (GIS) as a tool to improve resource management decisions is increasing at all levels of government and in the private sector across the country. Large databases are being developed for use in managing and manipulating geographic data. Such expansion reflects the growing appreciation of the utility of GIS. At the same time, efforts should be made to minimize the duplication of work brought about by such diversity of effort, to encourage the cooperative development of GIS technology, and to promote the creation and sharing of databases for use in a GIS.

This is the first report of the USDA GIS Work Group. The purpose of this report is to document the activities of USDA agencies in the use and management of geographic data, highlight areas of cooperative development, and provide a mechanism by which awareness of USDA activities may be increased within and outside the Department of Agriculture.

Establishment and Purpose of the GIS Work Group

On April 10, 1989, the Assistant Secretary, serving as the Chairman, Natural Resources and Environment Committee, established the USDA GIS Work Group. The Forest Service and Soil Conservation Service were appointed to co-chair the work group. The primary objectives assigned to the GIS work group were as follows:

> Ensure coordination of GIS activities within the Department and complete staff work required to address current and emerging GIS issues.
>
> Promote the development of Agency-wide, Department-wide, and/or Government-wide standards for digital databases that support comprehensive GIS use.
>
> Promote cooperation and data exchange with state and local government agencies that are developing and using GIS technology.

Federal GIS Coordination Activities

In 1983, the Office of Management and Budget (OMB) created the Federal Interagency Coordinating Committee for Digital Cartography (FICCDC) with the issuance of Circular A-16. FICCDC membership to comprises twelve departments and independent agencies. The purpose of this action by OMB was to bring about the coordination of the digital cartographic activities of federal agencies thereby avoiding duplication of effort and waste of resources.

In 1989, OMB rechartered FICCDC for three additional years with the following tasks:

1. Analyze its mission as it relates to an expanded role in coordinating Federal use of digital spatial data.

2. Recommend appropriate FICCDC activities beyond its current charter.

3. Review and recommend revisions to OMB Circular A-16 to incorporate Federal activities relating to digital spatial data.

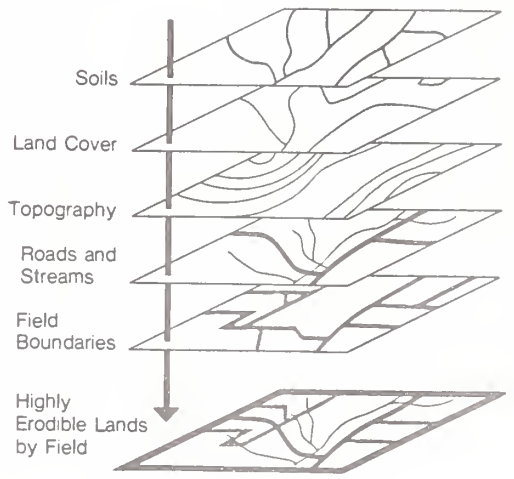
The FICCDC has recommended a revised OMB Circular A-16 that expands the breadth of coordination to include other types of spatial data. This recommendation included delegation of spatial data responsibilities to the following departments:

Interior - base topographic mapping, cadastral, geologic, and wetlands
Commerce - geodetic, cultural and demographic
State - international boundaries
Agriculture - soils and vegetation
Transportation - ground transportation

The revised Circular also permanently establishes a new interagency coordinating committee--the Federal Geographic Data Committee--to promote the coordinated development, use, sharing, and dissemination of surveying, mapping, and related spatial data. The objectives of the committee are to provide guidance and promote cooperation and coordination among Federal, State, and local government agencies and the private sector.

II. DESCRIPTION OF GIS TECHNOLOGY

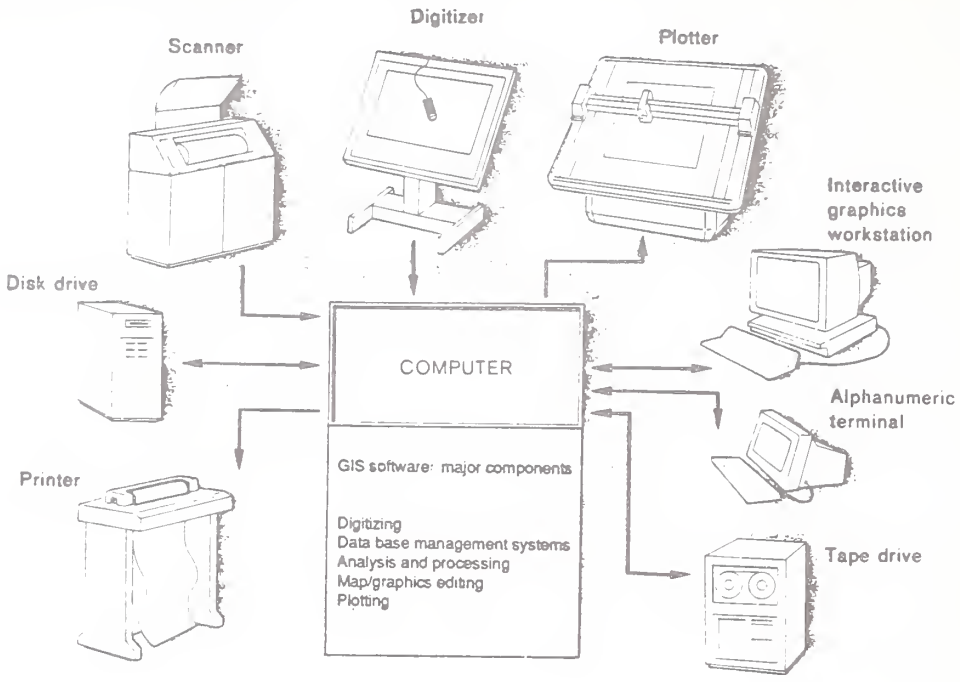
A Geographic Information System (GIS) is a computer-based technology that captures, stores, manipulates, analyzes, models, and displays the natural and artifical environment in multiple layers that are geographically referenced to locations on the earth's surface. GIS provides an efficient means for joining spatial or mapped data to descriptive attribute data for use by planners, resource managers, and a host of other professionals. The application of GIS technology provides users with a tool to solve problems and make decisions; GIS's are emerging as the spatial data handling tools of choice for solving complex geographical problems. Results of GIS analyses can be described in reports, tables, and most importantly in maps at virtually any scale.



Spatial information portraying such themes as soils, land cover, topography, roads, streams, and field boundaries are among those data layers typically used in a Geographic Information System (GIS) to produce interpretive maps and their related tabular data. Through an analysis function, for example, the GIS can generate map depicting the highly erodible cropland areas.

The four major components of a GIS are software, hardware, data, and people. While there were approximately 35 software systems in 1988, almost 100 GIS software systems exist today, both commercial and in the public domain. The primary functional components of a GIS can be grouped into the following broad categories:

- data creation and input (by digitizing, scanning, keying, etc.)
- import and export of existing digital data
- user interface
- database management and storage
- data manipulation, analysis, and processing
- display and product generation of maps, reports, and tables



Analytical functions and capabilities, ease of use, hardware, and complexity of software vary greatly among GIS systems. GIS software ranges from $500 to $200,000 per system.

Hardware used for GIS evolved from mainframes, to minicomputers, to personal computers and now to workstations. The rapid fall in the price of hardware and the increase in performance have helped make GIS affordable and more useful. Typical hardware components required for a GIS system include a computer with hard disk, tape drive, graphics terminal, digitizer, plotter and printer.

Data represents a significant share of costs in the use of a GIS. Some data capture and data entry methods can be very time consuming. Associated costs for data include acquisition of existing data, integration, reformatting, editing, archival, maintenance, management, and distribution. Standards for collecting and transferring spatial data in the federal sector are being established to eliminate the costly process of capturing similar data more than once and to ensure that no data will be lost during the transfer between different GIS systems.

The last component of a GIS is the people who use, support, and manage the GIS. Users of GIS within the USDA are cultural and natural resource specialists, land managers, and planners. Support for GIS is provided by the technical disciplines such as cartographers, computer systems analysts, and software developers. Managers primarily use GIS for decision making, program evaluation and policy formulation.

III. FY-90 ACCOMPLISHMENTS

The USDA GIS Work Group has been meeting on a monthly basis. Initial meetings were specifically designed to exchange information among USDA agencies and provide informative presentations from other Federal agencies with leadership responsibilities for geographic information. Recent meetings have focused on identifying cross-cutting issues that the work group should incorporate into its program of work.

Every two years the Federal Interagency Coordinating Committee for Digital Cartography (FICCDC) prepares a report regarding digital cartographic and GIS activities for OMB with information obtained from a survey questionnaire. This year the GIS Work Group coordinated the distribution and reply of the FICCDC questionnaire for USDA agencies and utilized this information in the preparation of the work group's FY-91 plan of work.

The General Accounting Office conducted a study of GIS activities at the Department of Interior, Agriculture, Commerce, and Energy, as well as the Army Corps of Engineers, the Federal Highway Administration, the Environmental Protection Agency, and the Federal Emergency Management Administration. General Accounting Office contact and report negotiations with USDA agencies were coordinated through the USDA GIS Work Group.

Members of the Work Group attended a government-wide conference regarding the proposed expansion of the FICCDC mission. Copies of the proposal were made available to all work group members and agenda topics were scheduled to brief and answer questions regarding FICCDC's proposal.

Section 8 of the Federal Land Exchange Facilitation Act of 1988, PL-100-49, called for a study and report concerning possible improvements in the handling (collection, storage, use, and dissemination) of information related to Federal and other lands. The Department of Interior conducted the study and their guidance focused on the collection and maintenance of land data, land information systems at various levels of government, and on improvements in surveying and mapping activities. The USDA GIS Work Group was utilized to review results of this "Land Information System Study" and ensure that the Department of Agriculture's values were reflected.

Specific meetings were organized to increase awareness of GIS and GIS activities for work group members. Following are the topics addressed at those sessions.

- Soil Conservation Service gave a slide presentation covering the basics of GIS technology. The presentation also covered the GRASS GIS implementation strategy. Information was distributed regarding GRASS and the SCS soil survey geographic databases.

- The Forest Service provided a briefing on the Forest Service Integrated Information Management Program which includes the plan to implement a service-wide GIS. Topics included scope, implementation and scheduling plans, administration, request for information and request for proposals process, costs and funding, database development, hardware configuration, utilization of GSA's Trail Boss project management program, and spatial database administration issues.

- U.S. Geological Survey gave an overview of USGS's organization and the relationships between the various divisions, USGS's support function for the FICCDC, an overview of the USGS National GIS Laboratory, and specific application projects.

- Two publications from the FICCDC were distributed to all members: "A Summary of GIS Activities in the Federal Government" and "A Process for Evaluating GIS's."

- The Bureau of Land Management presented information about BLM's GIS activities. A video tape was shown that described BLM's mission and GIS/LIS relationship to that mission. BLM's modernization effort was described. Components of the modernization effort include a major agency-wide procurement of information technology for the geographic coordinate database, automated land and mineral records systems, and automated resource data.

- U.S. Bureau of the Census provided an overview of the TIGER files. In 1981 Census set a goal to automate the full range of cartographic and geographic processes to serve the data collection, tabulation, and dissemination needs of the 1990 decennial census of the United States. The Geography Division designed and built, with the assistance of the U.S. Geological Survey, the Topologically Integrated Geographic Encoding and Referencing (TIGER) database to meet this goal. The Census Bureau will make available several nationwide graphic products from this database, including digital cartographic database extract files as well as the more traditional map products. Dates for planned versions of the TIGER/line files were also made available.

IV. FY-91 PLANS

An FY-91 plan of work has been discussed by the GIS Work Group and the following tasks have been identified:

- Coordinate the development of a USDA inventory of geographic databases and related attribute databases.

- Encourage and develop cooperative GIS projects among USDA agencies and with other federal agencies.

- Coordinate with and provide liaison to the Federal Geographic Data Committee (FGDC).

- Identify existing USDA geographic data standards and the need for the development of new data standards.

- Develop an action plan to reduce the impact of barriers for sharing geographic data within USDA. Future discussions will be held regarding the following barriers identified by the GIS Work Group:

  File format incompatibility
  Awareness of available data and their characteristics, format, and content
  Lack of standard terms and definitions
  Hardware limitations
  Data quality, i.e., much data exists without spatial referencing
  Data security
  Data resolution, scales, and level of detail
  Institutional
  Independence/self-sufficiency; no tradition of sharing data
  Identification of potential users; not knowing if someone else wants your data
  Identification of potential data sources.

V. AGENCY APPLICATION REPORTS

The following agencies have submitted individual summaries of GIS activities:

Agricultural Research Service
Animal and Plant Health Inspection Service
Cooperative State Research Service
Extension Service
Foreign Agricultural Service
Forest Service
National Agricultural Statistics Service
Soil Conservation Service

AGRICULTURAL RESEARCH SERVICE

AGENCY MISSION

The Agricultural Research Service administers basic and applied research in animal and plant production and protection; in management, conservation and improvement of soil and water resources for stable and productive agriculture; in processing, storage, marketing, and distribution of farm products; and in promotion of optimum human health and well-being through improved nutrition. This research is conducted in cooperation with federal and state agencies, universities, and private organizations.

GIS SOFTWARE AND COMPUTER EQUIPMENT

Hardware used for GIS is primarily microcomputers. A variety of software packages are used because the requirements in each application are different. Frequently used public domain software packages are Geographic Resources Analysis Support System (GRASS), Map Overlay and Statistical System (MOSS), and Map Analysis Program. Commercial packages used are ARC/INFO, ERDAS, EPPL, ELAS, SPANS, SURFER, and TAP.

GIS APPLICATIONS TO SUPPORT MISSION

The Agricultural Research Service uses GIS in studies pertaining to planning and management of land and water resources, rangeland productivity, landscape ecology, mapping of soils, vegetation, and animal geography. One major use is investigating the hydrologic characteristics of agricultural lands and watersheds to determine the spatial variability of surface and groundwater resources in order to study the transport of pesticides and other chemicals into the groundwater system.

Other small scale studies include mapping bee and other insect movements and spread of infestation. Seasonal vegetation maps derived from satellite observations characterize crop condition and productivity. The regional productivity is assessed through a GIS.

FUTURE PLANS

A major effort would be made to coordinate all GIS related activities within the agency. A forum would be set up to facilitate the exchange of information pertaining to selection and procurement of a GIS and the availability of databases from government and private sources.

ANIMAL AND PLANT HEALTH INSPECTION SERVICE

AGENCY MISSION

The mission of the Animal and Plant Health Inspection Service (APHIS) is to provide leadership to ensure the health and care of animals and plants, improve agricultural productivity and competitiveness, and contribute to the national economy and public health. APHIS accomplishes this mission by:

- Preventing exotic agricultural pests and diseases from entering the country;
- Detecting and monitoring agricultural pests and diseases;
- Managing agricultural pests and diseases;
- Providing scientific and technical services;
- Facilitating agricultural exports;
- Protecting the welfare of animals;
- Protecting endangered species; and
- Collecting, analyzing, and disseminating information.

GIS SOFTWARE AND COMPUTER EQUIPMENT

The hardware platforms used are microcomputers based on either the 20 megahertz Intel 80386 processor (AT&T 6383E) or the 16 megahertz Motorola 68030 processor (Apple Macintosh IIx). Two software programs are used on the AT&T microcomputers: ATLAS*GIS from Strategic Mapping, Inc. based on the MS-DOS operating system and Genamap from Genasys Corporation based on the UNIX operating system. Three software programs are being tested on the Apple Macintosh IIx systems using Apple System 6: MapGrafix from ComGraphix, Inc., MapMaker from Strategic Mapping, Inc., and a HyperCard program developed in-house. All systems output to either standard plotters or laser printers.

The standard database system presently used by APHIS is ORACLE. The map files are digitized Public Land Survey, Digital Line Graph files from USGS, and TIGER files from the Census Bureau.

GIS APPLICATIONS TO SUPPORT MISSION

A GIS advisory group was formed in October 1989 to determine needs of the Veterinary Services and the general needs of APHIS for electronic mapping and statistical mapping applications. The mission of the GIS group was to gain an understanding of where and how geographic data can be used in the control of epidemics, the tracking of foreign and domestic animals, and the management of animal health. Five pilot projects were identified using the two hardware platforms and five different GIS software systems. The major emphasis of the pilot projects is to learn the benefits, costs, and problems associated with GIS. It is expected that the information gained from using these GIS programs can be applied within the other units of APHIS.

The computing configuration of software and equipment for the pilot projects must provide for a combination of distributed processing and limited networking. A central repository computer for the base maps and central database is needed at the national or state level. This computer can share data and map files with smaller computers in field locations. At the field level, local data editing and entry of spatial data can be managed as the herds and flocks are tested. This allows for the creation of map overlays that represent farms with herds and flocks located throughout the area being worked. These two levels of computers can be networked periodically for the transfer of map data, updated ORACLE data files, and other programs.

APHIS GIS projects include the implementation of a database design over a limited geographic area. Microcomputers are used to minimize cost. The following applications of GIS are being tested:

- Identify software and equipment configurations required to reflect operations at national, state, and field levels;

- Ability to spatially locate herds or flocks infected with a disease, such as Brucellosis, within a limited area of a state, i.e., 2-3 counties;

- Provide effective interaction with a national database using ORACLE and spatial data files for a limited area; and

- Determine functions, attributes, and data layers of the GIS pilot projects that are the most important to agency program needs.

The intent is to show the graphic representation of herds or flocks and disease location. This technology should provide APHIS with a greatly improved method over standard computerized reporting formats for determining the stage of the disease being tracked, predicting its spread, and measuring the success of a program's approach to the control and eradication of the disease.

FUTURE PLANS

APHIS identified several objectives of the pilot projects. Paramount is the determination of the value of GIS as a tool in the control and eradication of animal disease. Second, identification of standards for GIS program and spatial database needs which can be applied to the GIS needs of other APHIS units, such as Plant Protection and Quarantine. Finally, measurement of the level of use and of need for a national procurement of GIS or related mapping systems. Future plans depend on the results of these pilot projects.

COOPERATIVE STATE RESEARCH SERVICE

AGENCY MISSION

Cooperative State Research Service (CSRS) focuses on the advancement of science and technology in support of agriculture, forestry, people, and communities. This is accomplished in partnership with the state agricultural experiment station system, colleges, universities, and other research organizations, and in concert with the Secretary of Agriculture and the intent of Congress.

GIS SOFTWARE AND COMPUTER EQUIPMENT

CSRS has no specific equipment or software devoted to GIS. CSRS does not control the equipment and software used by its partner institutions. Practically all types of equipment and software are in use at some point within the partnership.

GIS APPLICATIONS TO SUPPORT MISSION

CSRS has supported the development of integrated GIS and remote sensing programs for the inventory, analysis, and management of the resources with which it is concerned. This development, done by its partners with support through CSRS, provides a framework for the organization of data essential to the advancement of science and technology.

CSRS does not directly develop or use GIS technology, but supports its partner institutions in such development. The technology these institutions have developed provides some demonstration capability and gives an opportunity for research but the use of GIS is most often as a tool for the specific research project.

CSRS has no specific budget for GIS. Its partner institutions budget as required for the development of GIS technology through their research and/or extension programs. Between one and two million dollars per year are spent from federal sources. These are augmented by state funds at a ratio close to three to one. In addition, many of the development efforts of other federal agencies are supported through partner institutions and the partner institutions are supported by funding from these agencies.

FUTURE PLANS

There are no planned GIS procurements for CSRS.

EXTENSION SERVICE

AGENCY MISSION

The Extension Service (ES) is the Federal partner of the Cooperative Extension System (CES). The mission of ES is to assure an effective, nationwide CES that is responsive to priority needs and the Federal interests and policies with quality information, education, and problem-solving programs. The mission of the CES (Federal, state, and county partners) is to help people improve their lives through an educational process that uses scientific knowledge, focused on issues and needs.

GIS SOFTWARE AND COMPUTER EQUIPMENT

ES itself has no specific equipment or software devoted to GIS. State and county partners may have access to GIS through their respective Land Grant universities and sometimes through state and local jurisdictions, as is appropriate to their mission. GIS's potential value is through improved decision-making and planning by local government officials who have learned to use GIS. ES and its cooperators need to improve their own capacity to deliver information relative to GIS. CES will soon be connected to NSFNET, which will greatly increase CES's capacity to utilize massive databases.

GIS APPLICATIONS TO SUPPORT MISSION

The educational programs of Extension encompass that body of knowledge and information that resides within the Land Grant universities that is applicable to addressing the issues and needs that have been identified through an issues-programming process. Some individual State Extension Services are heavily involved in GIS. Others have just begun to explore the possible uses of GIS by clientele.

FUTURE PLANS

There are no planned GIS procurements for ES. Procurement by cooperators will depend on individual circumstances. The Cooperative Extension System will educate its local government and clients about the potential of using GIS, when applicable. The payoff of GIS in Extension is not through Extension having its own GIS system but through Extension clients wisely selecting and efficiently using their own GIS systems. Extension education can also help local governments coordinate local level GIS information needs to maximize the value of their investment in GIS.

FOREIGN AGRICULTURAL SERVICE

AGENCY MISSION

The mission of the Foreign Agricultural Service is to expand foreign markets for U.S. farm commodities by gathering, analyzing, and disseminating information on foreign market supply and demand situations; working to gain access to foreign markets; and working to promote increased foreign consumption and utilization of domestic agricultural commodities.

GIS SOFTWARE AND COMPUTER EQUIPMENT

Current hardware to support GIS applications in Foreign Agricultural Service consists of four (4) International Imaging Systems display and analysis stations, four (4) SUN workstations, a DEC VAX 8800 with hard disks capability to store digital satellite imagery and data base elements of meteorological data and model output on a grid cell bases. The GIS data base was developed in the early 1980's using DBMS technology. We have the capability to extract and display output in both soft and hard copy.

GIS APPLICATIONS TO SUPPORT MISSION

The GIS application in Foreign Agricultural Service was developed to support the mission of gathering, analyzing and determining the foreign supply situation of small grains, coarse grains, and oilseed crops in selected areas of the world. Satellite imagery from the Landsat and Metsat systems is used in conjunction with meteorological data and reports from agricultural attaches to estimate total crop production.

FUTURE PLANS

A major upgrading to Foreign Agricultural Service System consists of acquiring the four SUN workstations and adapting the public domain GRASS software so that the elements in our current data base can be more effectively analyzed. We hope to implement crop yield and production models being developed by the research community.

FOREST SERVICE

AGENCY MISSION

The USDA Forest Service is to provide a sustained flow of resources such as outdoor recreation, forage, wood, water, wilderness, wildlife, and fish in a combination that best meets both current and future needs. The agency also has the federal responsibility for national leadership in forestry.

GIS SOFTWARE AND COMPUTER EQUIPMENT

Current hardware to support GIS throughout the Forest Service includes 94 minicomputers, 29 microcomputers, 11 workstations, and 4 hardware systems external to the Forest Service (other agencies and universities). GIS software in use on this current hardware includes both public domain and commercial packages. The pubic domain software used includes the Map Overlay and Statistical System (MOSS), Geographical Resources Analysis Support System (GRASS), and the Data General version of the Forest Service's Wildland Resource Information System (DWRIS). Commercial software used includes ARC/INFO, ERDAS, Spatial Analysis System (SPANS), and Data General's GEO system. The split between public domain and commercial software use is approximately equal.

GIS APPLICATIONS TO SUPPORT MISSION

The Forest Service uses GIS at 138 of its 880 offices located nationwide. GIS is used to support forest management projects and explore other applications related to the agency's mission.

Since the mid-1970's, it has been apparent that one of the key deficiencies in application of computer technology to resource management has been in the spatial questions to be addressed. For example, timber harvest planning on National Forests has made widespread use of operations research techniques. However, implementation of these plans is constrained not so much by total volume as having an appropriate place to cut. There are many other examples of critical spatial questions that could not be well addressed by earlier technologies. Recent developments in computer hardware and software have indicated that some of these spatially based questions are now more achievable.

The Forest Service objective is not better maps, but better decisions. A useful technology must facilitate data management, analysis and display for those who make resource management decisions. The analyses also must be clear to non-Forest Service individuals and groups that are concerned with Forest decisions

To date, applications of GIS by the Forest Service have emphasized identification and analysis of resource management decision problems that have a strong spatial dimension. Much of the available data is timber related, but most of the analyses have addressed questions in Forest Pest Management, Wildlife Habitat Management, and Fire Management, with a few examples across other resource areas. In wildlife, GIS has been used to identify protection buffers for threatened and endangered species such as spotted owl and red cockaded woodpecker. Detailed habitat studies

have been published for grizzly bear, elk, and Kaibab mule deer. Additional background studies are underway for several other wildlife habitat problem areas, such as moose/wolf interactions in northern Michigan.

In order to address critical national environmental and economic issues, we must integrate jour information into an electronic medium where it can be readily accessed and easily shared. GIS technology provides the only comprehensive tool that can facilitate more ecologically based policy decisions.

FUTURE PLANS

The Forest Service is planning to acquire a new nationwide system that will integrate GIS, administrative, scientific, technical, and telecommunications applications. The objective is to implement and internalize Geographic Information System capability throughout the Forest Service over the next eight years to enable the agency to become more responsive to the public needs and better achieve its mission.

Using a Benefit Cost Analysis and Feasibility Study, the Forest Service has examined alternatives for placing GIS capabilities in all of the 880 field sites. A Delegation of Procurement Authority has been received from the General Services Administration. Forest Service plans included issuing a request for proposals (a procurement document) by the end of March 1990. However, issuance of that request has been postponed pending final external review and authorization to proceed.

NATIONAL AGRICULTURAL STATISTICS SERVICE

AGENCY MISSION

The primary mission of the National Agricultural Statistics Service is to provide accurate, timely, statistical information and services for and about agriculture and rural America.

GIS SOFTWARE AND COMPUTER EQUIPMENT

UNIX-based Sun SPARC station is the main platform for GIS use in NASS. There will be some applications where PC/DOS-based computers will be used, primarily with smaller data sets and less intensive analysis or for applications to be ported to other users.

ARC/INFO is utilized on the Sun workstations as NASS initially researches the applications of GIS technology. In addition, several PC-based packages are being reviewed for possible applications.

GIS APPLICATIONS TO SUPPORT MISSION

NASS has been given the responsibility to build a GIS database as part of USDA's Water Quality Program Plan to support the President's Water Quality Initiative. The objective of the water quality plan is to determine, on a national basis, the locations and relative intensities of potential water quality problems which are independently indicated by concomitant geographic occurrence of specific geomorphic systems, soil types, geologic sequences, vulnerable water systems, land users, agricultural practices, farm types, and weather systems. Data collected in the Delmarva region will be the first application of GIS technology in NASS, followed by the compilation of nationwide agricultural chemical usage data.

FUTURE PLANS

Several research projects using GIS are being explored for feasibility, including:

- analysis of existing data sets
- tracking of sampled area segments
- setting enumerator workload assignments
- aiding area frame stratification and sampling

SOIL CONSERVATION SERVICE

AGENCY MISSION

The Soil Conservation Service (SCS) helps farmers, landowners, industry, state and local governments, other countries, and others in the conservation and wise use of soil, water, and related natural resources on federal land. The help SCS provides is technical and financial. The SCS mission covers three major areas:

- Soil and water conservation
- Natural resource surveys
- Community resource protection and management

GIS SOFTWARE AND COMPUTER EQUIPMENT

In 1988, SCS selected the Geographic Resource Analysis Support System (GRASS) software as the agency supported GIS. GRASS is a public domain GIS originally developed by the U.S. Army Construction Engineering Research Laboratory. GRASS runs on the AT&T 6386 computers and the UNIX operating system purchased from the Department's AMPS contract.

GRASS was selected because it was public domain, written in "C" language for the UNIX operating system, easily portable to SCS hardware, well-designed, easy to use in comparison with other GIS software, as functional as the leading commercial software, and because it has an established development, support, and user community.

SCS has 95 sites running GRASS: State offices and field offices, National Headquarters, and four National Technical Centers.

GIS APPLICATIONS TO SUPPORT MISSION

The SCS extensively uses a wide range of natural resource data that is referenced by geographic or spatial locations on maps and aerial photographs. Most of the data is collected, stored, analyzed, and output by manual methods. The implementation and use of GRASS gives SCS an automated working tool to perform more sophisticated analysis of multiple geographic data layers in less time. GRASS provides SCS users accurate answers to complex resource problems, supports decision making at all levels within SCS, and assists land users in making decisions based upon interpretation of all natural resources data available.

The application of GRASS within SCS is summarized under each of the following of the following four major types of GIS capabilities:

1. **GIS Programming.** The SCS GIS implementation strategy is to put the analysis tool of GRASS in the hands of our technical disciplines and decision makers. Implementing a complex technology like GIS poses a problem with our intended users who lack computer, GIS, and GRASS expertise. As a result, SCS is developing and programming menu-driven GIS interfaces to allow infrequent users of GRASS to generate the most frequently required application products with little or no knowledge of GIS or GRASS. GRASS links to non-geographic soil and client databases have been completed and are being tested. These interfaces will produce soil interpretative maps showing highly erodible lands, septic site locations, slope determinations, fertilizing application rates, etc., by county or individual land parcels.

2. **Database Development.** Before the full use of GIS can be realized, geographic data must be digitized or existing data must be imported. GRASS is being used to digitize natural resource data such as soils, hydrologic units, and farm and field boundaries. Mapping and digitizing specifications have been adopted for digitizing. A new digitizing software package was developed cooperatively by SCS and the Forest Service which utilizes map scanning technology and greatly increases our digitizing efficiencies. A Memorandum of Understanding was established with the Census Bureau to obtain and revise TIGER line files. Software was written by SCS to import TIGER files to GRASS.

   The SCS was assigned to responsibility by OMB to coordinate the development and use of soils spatial data.

3. **Data Analysis.** GRASS provides SCS the capability to interpret and analyze spatial information which is often impractical when using manual methods. Activities and programs which GRASS will support are:

   - Watershed project planning and monitoring,
   - Water quality analysis,
   - RC&D project planning analysis,
   - County natural resource analysis,
   - Farm and ranch conservation planning,
   - National-level policy analysis of national databases,
   - Development of soil survey geographic databases,
   - Delivering soils information to the public, and
   - Workload analysis and priority setting.

Actual applications that use GRASS include:

- Targeting non-point-source pollution,
- Selecting areas suitable for watershed structures,
- Determining areas eligible for the Conservation Reserve Program,
- Describing the status of program activity,
- Performing analysis of the National Resource Inventory,
- Interpreting soils data with other natural resource data to locate potential areas having severe ground water contamination, and
- Producing custom planimetric base maps from TIGER data.

4. **Data Presentation.** The SCS developed a GRASS interface to a map composition plotting package called MAPGEN. This interface produces high quality cartographic products.

FUTURE PLANS

Future plans for GIS within SCS include the following:

- Continue to work on developing GRASS interfaces to other SCS software and databases in order to customize GRASS use for SCS applications, particularly water quality management.

- Concentrate on developing and supporting application projects which demonstrate the power and use of GRASS GIS technology in support of the SCS mission.

- Support the need for graphic workstations for use with GRASS and other SCS application software.

- Continue to expand the training and other user support services to our State and field offices from the National Cartographic Center and the National Technical Centers.

- Improve GIS expertise in SCS National Technical Centers and State offices.

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